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JUN 26 2019

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PPPO-03-5654239-19

Mr. Jonathan Edwards, Director
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Ms. Jessica Kuenzil, DAPC Manager
Ohio Environmental Protection Agency
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Logan, Ohio 43138

Dear Madam and Sirs:

NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS RADIONUCLIDE EMISSIONS REPORT FOR CALENDAR YEAR 2018

Enclosed please find the U.S. Department of Energy (DOE) transmittal of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) Radionuclide Emissions Report for calendar year (CY) 2018 from the DOE Portsmouth Gaseous Diffusion Plant (PORTS).

DOE owns the PORTS site, which has radionuclide air emissions from DOE operations. DOE leases a portion of the site to Centrus Energy Corporation (Centrus); however, Centrus had no emissions in 2018 therefore this report covers only DOE emissions.

The dose to the maximally exposed individual resulting from DOE operations was calculated at 0.10 millirem (mrem) for CY 2018, which is below the regulatory standard of 10 mrem per year.

If you have any questions, please contact Amy Lawson of my staff at (740) 897-2112.

Sincerely,

Jeffrie A. Bettinger
Portsmouth Site Lead
Portsmouth/Paducah Project Office

Enclosure:
Certified copy of the 2018 Annual NESHAP Radiological Report

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Radiological National Emission Standards for Hazardous Air Pollutants (NESHAP) 2018 Annual Report for the Department of Energy Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0931&D1

June 2019

This document has been approved for public release:

Samuel C. Eldridge (signature on file) 05/29/2019
Classification & Information Officer Date

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Radiological National Emission Standards for Hazardous Air Pollutants (NESHAP) 2018 Annual Report for the Department of Energy Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0931&D1

June 2019

Prepared by
Fluor-BWXT LLC, Under Contract DE-AC30-10CC40017

FBP-ER-RCRA-WD-RPT-0391, Revision 2

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The following certifications pertain to the U.S. Department of Energy (DOE) activities at the Portsmouth site.

DOE Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 *U.S.C.* 1001.

Jeffrie A. Bettinger
Portsmouth Site Lead
Portsmouth/Paducah Project Office
U.S. Department of Energy

6/26/19
Date

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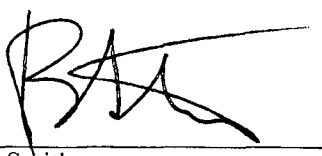
Fluor-BWXT Portsmouth LLC Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 *U.S.C.* 1001.



6/25/19

Bobby D. Smith
Site Project Director
Fluor-BWXT Portsmouth LLC (Operator)
(For information pertaining to Fluor-BWXT Portsmouth LLC sources)

Date

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Mid-America Conversion Services, LLC

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 *U.S.C.* 1001.

T. Zach Smith
President and Project Manager
Mid-America Conversion Services, LLC (Operator)
(For information pertaining to the DUF_6 conversion facility)

6/25/19
Date

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TABLES

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ACRONYMS

CAP88-PC	Clean Air Assessment Package
Centrus	Centrus Energy Corporation
CFR	Code of Federal Regulations
Ci	curie
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
FBP	Fluor-BWXT Portsmouth LLC
HEPA	high efficiency particulate
HVAC	heating, ventilation, and air conditioning
MCS	Mid-America Conversion Services, LLC
MEI	maximally exposed individual
mrem	millirem
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
pCi	picocurie
PORTS	Portsmouth Gaseous Diffusion Plant
U_3O_8	triuranium octaoxide
UF_6	uranium hexafluoride
U.S. EPA	U.S. Environmental Protection Agency

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EXECUTIVE SUMMARY

This report provides the information required by Title 40 of the *Code of Federal Regulations (CFR)* Part 61, National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy (DOE) Facilities.

DOE owns the Portsmouth Gaseous Diffusion Plant (PORTS) site. PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 through 2001, is currently undergoing decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities. DOE contractor Fluor BWXT Portsmouth LLC (FBP) is responsible for radionuclide air emission sources associated with the process buildings and associated facilities.

Mid-America Conversion Services, LLC (MCS) operated the depleted uranium hexafluoride (DUF_6) conversion facility as a DOE contractor in 2018. MCS has operated the facility since February 1, 2017. The DUF_6 conversion facility was built to process DUF_6 produced by the gaseous diffusion process. The conversion facility processes DUF_6 cylinders via a fluidized bed system to produce uranium oxide and salable hydrofluoric acid. This facility has only one emission source which emits through the conversion building stack.

Additionally, DOE leases a portion of the site to Centrus Energy Corporation (Centrus) (formerly United States Enrichment Corporation). All Centrus sources have been shut down and there are no emissions to report for 2018.

Radionuclide emissions from the combined DOE and DUF_6 sources are modeled by the Clean Air Assessment Package (CAP88-PC) Version 4.0 computer program [approved by the United States Environmental Protection Agency (U.S. EPA)] to estimate the effective dose to members of the public. In 2018, the maximally exposed individual (MEI) was located 3284 meters north of the X-627 Groundwater Treatment Facility and received a combined effective dose of 0.10 millirem (mrem)/year from all DOE point sources of radiological air emissions. This dose of 0.10 mrem/year is well below the NESHAP limit of 10 mrem/year.

A Memorandum of Understanding between DOE and U.S. EPA (DOE and U.S. EPA 1995) requires evaluation of airborne emissions from diffuse emission sources, in addition to the point sources evaluated to determine compliance with the 10 mrem/year limit. DOE collects samples from 15 ambient air monitoring stations located on and near the PORTS reservation and analyzes them for the radionuclides that could be present in ambient air due to PORTS activities. These radionuclides are isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238), technetium-99, and selected transuranic isotopes (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). The ambient air monitoring stations measure radionuclides released from the DOE point sources, fugitive air emissions, and background concentrations of radionuclides.

The CAP88-PC model was used to generate a dose conversion factor that was used to calculate a dose (in mrem/year) for a given activity of each radionuclide in air (in picocuries per cubic meter). A dose was computed for each ambient air monitoring station. The net dose for each ambient air monitoring station (subtracting the dose measured at the background station) ranged from 0 (at stations with a gross dose less than the background station) to 0.059 mrem/year. These results indicate that fugitive emissions of radionuclides from the PORTS reservation do not cause a significant dose to individuals near the site and further demonstrate that emissions of radionuclides from PORTS are well below the NESHAP limit of 10 mrem/year.

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1. FACILITY INFORMATION

1.1 SITE DESCRIPTION

Department of Energy (DOE) owns the PORTS site. PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 through 2001, is currently undergoing decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities. DOE contractor Fluor BWXT Portsmouth LLC (FBP) is responsible for radionuclide air emission sources associated with the process buildings and associated facilities.

Mid-America Conversion Services, LLC (MCS) operated the depleted uranium hexafluoride (DUF_6) conversion facility in 2018. The facility was built to process DUF_6 produced by the gaseous diffusion process. The conversion facility processes DUF_6 cylinders via a fluidized bed system to produce uranium oxide and salable hydrofluoric acid. This facility has only one emission source which emits through the conversion building stack.

Additionally, DOE leases a portion of the site to Centrus Energy Corporation (Centrus) (formerly United States Enrichment Corporation). All Centrus sources have been shut down and there are no emissions to report for 2018.

1.2 SOURCE DESCRIPTION

DOE is responsible for a number of point sources regulated by the U.S. Environmental Protection Agency (U.S. EPA) under the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H.

1.2.1 MAJOR SOURCES

In accordance with 40 *Code of Federal Regulations* (CFR) 61.93(b)(4)(i), major sources identified as having potential emissions of radionuclides which could cause an effective dose equivalent greater than 1% of the standard (10 mrem/yr) are continuously monitored. When operating, these major sources are monitored by flow-proportional, isokinetic samplers to provide emissions data.

As D&D progresses within the process buildings, major sources associated with the former gaseous diffusion plant are being permanently shut down. Table 1 lists the active, inactive, and permanently shut down major DOE sources at PORTS. The sources that are permanently shut down are not discussed further in this report.

Table 1. PORTS Major Sources

Active and Inactive Sources	
Location	**Vent Identification Number**
X-330 Process Building Cold Recovery/Building Wet Air Evacuation Vent 1	X-330-A-272
X-333 Process Building Wet Air Evacuation Vent	X-333-P-856
X-333 Process Building Cold Recovery Vent (INACTIVE)	X-333 P 852
X-344A Cold Trap Vent	X-343-P-468
X-344A Gulper Vent	X-344-P-929
DUF_6 Conversion Building Stack	X-1700-001
Sources Permanently Shutdown	
Location	**Vent Identification Number**
X-326 Process Building Emergency Jet Vent	X-326-P-616
X-326 Process Building Top Purge Vent	X-326-P-2799
X-326 Process Building Seal Exhaust Vent (Area 6)	X-326-A-540
X-326 Process Building Seal Exhaust Vent (Area 4)	X-326-A-512
X-326 Process Building Side Purge Vent	X-326-P-2798
X-326 Process Building Seal Exhaust Vent 5	X-326-A-528
X-330 Process Building Seal Exhaust Vent 3	X-330-A-279
X-330 Process Building Seal Exhaust Vent 2	X-330-A-262
X-333 Process Building Seal Exhaust Vent 1	X-333-A-851
X-343 Cold Trap Vent	X-343-P-468

X-330 Process Building and X-333 Process Building Cold Recovery Systems

The cold recovery systems are intermittently operated maintenance support systems used to prepare cascade equipment (e.g., cells) for internal maintenance. There are two cold recovery systems at PORTS with one each in the X-330 Process Building and X-333 Process Buildings. In the X-330 Process Building, the cold recovery system shares a common vent and vent sampler with the building wet air evacuation system. Only the X-330 Process Building Cold Recovery System continues to operate as needed to support projects. The X-333 Process Building Cold Recovery System is currently inactive, but is available for use if needed.

X-330 Process Building and X-333 Process Building Wet Air Evacuation Systems

The building wet air evacuation systems are intermittently operated maintenance support systems. There are two building wet air evacuation systems, one associated with each of the cold recovery systems described above for the X-330 Process Building and for the X-333 Process Building. In the X-330 Process Building, the cold recovery and building wet air evacuation systems share a common vent and sampler.

The Building Wet Air Evacuation System continues to operate to support projects. Both of the Building Wet Air Evacuation Systems were active in 2018.

X-344A Cold Trap and Gulper Vents

The X-344A uranium hexafluoride (UF_6) Sampling Building contains a sampling and transfer system for sampling the product and for filling customer cylinders with low assay UF_6. The term "assay" refers to the concentration of uranium-235 in weight percent. The X-344A Cold Trap is equipped with radiation monitors to track the accumulation of radioactive material in the sampler traps in real-time. In the event of a trace release occurring in spite of the purge and evacuation procedure, a "gulper" is mounted behind the manifold-to-cylinder connections. The gulper is simply a continuous vacuum nozzle, similar in principal to a lab hood, which draws any small releases from the room air into a filtration system. The filtration system has two filter banks, each consisting of a roughing filter followed by high efficiency particulate air (HEPA) filters and a centrifugal blower. The X-344A facility was in operation during 2018.

DUF_6 Conversion Facility

The DUF_6 conversion facility produces uranium oxide dust that is primarily in the form of triuranium octaoxide (U_3O_8). Multiple prefilters and primary HEPA filter banks within the facility heating, ventilation, and air conditioning (HVAC) system control particulate emissions of oxide powder. Prior to atmospheric venting of process off gas through the stack, air passes through a secondary set of HEPA filter banks. The conversion building is also maintained at negative pressure to help eliminate the possibility of fugitive emissions.

1.2.2 MINOR SOURCES

PORTS has a number of unmonitored and potential emission sources associated with process support and groundwater treatment activities. These minor sources are point sources that have the potential to emit radionuclides that produce a dose less than or equal to 0.1 mrem/yr. Emissions from these sources are evaluated in accordance with 40 *CFR* 61.93(b)(4)(i), which states:

> *"For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions."*

The potential sources are primarily room ventilation exhausts and/or pressure relief vents from areas that have a potential for an internal radionuclide release.

X-705 Decontamination Facility

Equipment that is removed from the PORTS cascade is covered with tarp bags at the point of removal and transported to the X-705 Decontamination Facility. Small parts may be cleaned in hand tables, while large parts may be sent through an automated tunnel. The hand tables consist of shallow acid baths where metal parts can be decontaminated by passive soaking. The hand tables have fume hoods over them to protect workers from acid fumes. Pressure relief vents are standard on such equipment. The tunnel is an enclosed series of "booths" that can decontaminate large parts by spraying with decontamination solutions as a small dolly carries the parts through the tunnel. The tunnel is ventilated to prevent a buildup of acid fumes. In all cases, radionuclides (uranium and technetium) are dissolved in the liquid phase and collected for recovery of the uranium. None of the radionuclides are volatilized through normal operation of these facilities and only trace radionuclides carried by entrained droplets would be expected.

X-705 Calciners

Solutions are processed in the Uranium Recovery Area to yield a concentrated uranyl nitrate solution, which is converted into uranium oxide powder in one of two calciners located in X-705. A calciner consists of an inclined heated tube with the uranyl nitrate solution entering at the top and air entering at the bottom. The uranium is first dried and then oxidized as it passes down the tube. The uranium oxide powder is collected directly into a five-inch diameter storage can at the lower end of the calciner tube. The gaseous stream leaves the upper end of the calciner and is exhausted through a scrubber for nitrogen oxides control. Uranium is recovered from the spent scrubber solution through a microfiltration process and the effluent is discharged to a National Pollutant Discharge Elimination System (NPDES) permitted outfall. Turbulence and flow rates through the calciners are controlled to minimize blowback of the uranium oxide. Any blowback that does occur is entrapped by the entering uranium solution. The X-705 calciners were not in operation in 2018.

X-705 Glove Boxes

The five-inch can that collects the uranium oxide powder from each calciner is housed in a glove box to prevent the loss of the material. In addition, there is a separate glove box which is used for sampling the material in the can. The glove boxes have air locks for the entry and removal of work materials and are maintained under negative pressure during use. This negative pressure is produced by an exhaust fan drawing through a HEPA filter. The X-705 Glove Boxes were not in operation in 2018.

X-705 Storage Tank Vents

Uranium-bearing solutions awaiting treatment are stored in five-inch diameter tanks inside the X-705 facility. All of these tanks are manifolded to a common pressure relief vent that has some potential to release radionuclides if the tanks are overfilled or overheated. Normal emissions should be zero since the stored liquids are quiescent, the dissolved radionuclides are non-volatile, and the vents are not open except during filling. The storage tank vents were not in operation in 2018.

X-705 and X-710 Laboratory Fume Hoods

Laboratory analysis of process and other samples is performed in the PORTS on-site laboratory in accordance with standard laboratory practices. There are no emissions controls on the lab hoods used in these procedures. The hoods should not exhibit any measurable radionuclide emissions during normal

operation. Most laboratory fume hoods are located in the X-710 Laboratory. The X-705 Decontamination Facility also has a small laboratory which contains three fume hoods which were used to prepare samples and analyze materials being processed in the building. This laboratory has been out of service for several years, but could be used again in the future.

The X-710 Laboratory is in routine use. Consequently, emission estimates were included in the source term for the dose modeling using Clean Air Assessment Package (CAP88-PC).

XT-847 Glove Box

The XT-847 Glove Box is a large stainless steel glove box which is used to batch small quantities of radioactively contaminated waste for more efficient and less costly storage, shipment, and disposal. The primary waste stream involved is spent alumina and other adsorbents used in control traps on process vents. When the adsorbent is removed from use, it is placed in a safe geometry container (5", 8" or 12" diameter, depending on assay). The material is then analyzed, and if the uranium content meets nuclear criticality safety limits, it is batched into larger containers including, but not limited to, 55 gallon drums. Other radiological materials may also be handled in the glove box. The XT-847 Glove Box exhausts through a HEPA filter and is normally in routine use. However, the Glove Box was not in operation in 2018.

X-326 Process Building L-cage Glove Box

The X-326 Process Building L-cage Glove Box was used to sample, batch, blend, or repackage material contaminated with radionuclides and generated low emissions of radionuclides. This Glove Box was permanently shut down in 2017.

X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities

The X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities treat groundwater contaminated with volatile organic compounds and radionuclides, and release treated water through permitted NPDES outfalls. To reduce air emissions of volatile organic compounds from the groundwater treatment facilities, a de-mister is installed on the air stripper at X-622, and off-gas carbon units are installed on the air strippers at the X-623, X-624, and X-627 facilities. The clarifier at the X-622 Groundwater Treatment Facility is part of the treatment process and is vented to the environment. No control equipment is installed at any of the groundwater treatment facilities to reduce emissions of radionuclides. Radiological emissions from the groundwater treatment facilities do not exceed 10 percent of the standard (10 mrem per year). Therefore, in accordance with 40 CFR 61.93, radiological monitoring of these units is not required.

X-735 Landfill

The current Permit-to-Install and Operate for the venting system at the X-735 Landfill, issued by the Ohio Environmental Protection Agency, includes a requirement for compliance with NESHAP Subparts A (General Provisions) and H (National Emission Standards for Emissions of Radionuclides Other Than Radon from DOE Facilities), although the NESHAP provisions are administered directly by U.S. EPA.

The results of air emissions testing of the X-735 Landfill venting system, performed from September 25 through September 29, 1995, were used to calculate radionuclide emissions from the landfill. During the testing, samples were collected from a uniform pattern of 16 of the 33 landfill vents and analyzed for gross alpha activity and gross beta activity. Alpha activity was not detected in any of the samples. Beta activity was detected in 1 of the 16 samples at one picocurie (pCi)/sample, which was just above the analytical detection limit of 0.9 pCi/sample.

In the *Performance Test Report X-735 Landfill Closure (Northern Portion) Cap Construction and Gas Venting System* (DOE 1995), the average beta activity per cubic meter per vent was calculated using the conservative assumption that beta activity was being emitted at half the detection limit in the 15 vents in which beta activity was undetected. Emissions of beta activity for all 33 vents were calculated as 0.00213 pCi/min (DOE 1995).

For compliance with NESHAP Subpart H regulations, beta emissions were conservatively assumed to be technetium-99, the only radionuclide associated with PORTS activities that is a beta emitter (the transuranics and uranium isotopes associated with PORTS are alpha emitters). Because alpha activity was not detected in the emissions testing, it is not included in the dose assessment. The annual emission rate of 0.0000000011 (1.1E-09) curie (Ci)/year of technetium-99 results in a dose of 0.000000941 (9.41E-07) millirem (mrem)/year to an individual 50 meters north of the X-735 Landfill at the PORTS property boundary. Because the dose from the X-735 Landfill venting system is more than one million times smaller than the doses from the other DOE sources and more than one billion times smaller than the regulatory limit of 10 mrem/year, the X-735 Landfill venting system is not a major contributor to the DOE dose and will not be discussed in the remainder of this report.

2. RADIONUCLIDE EMISSIONS

Section 2.1 discusses the methods used to calculate radionuclide emissions from each of the DOE sources that emitted radionuclides during 2018. Table 2 presents a summary of the radionuclide emissions from DOE sources in 2018.

Table 2. Grouped Emissions[a] (Ci/year) from DOE Air Emission Sources in 2018

Radionuclide	Group 1	Group 2	Group 3	DUF_6 facility
Americium-241	3.16E-07		3.42E-06	
Neptunium-237	2.89E-06		1.69E-05	
Plutonium-238	5.05E-07		9.21E-07	
Plutonium-239/240[a]	1.67E-07		3.49E-05	
Technetium-99	4.88E-05	1.67E-03	7.43E-02	
Uranium-233/234[a]	3.96E-05	7.26E-06	6.53E-04	1.44E-06
Uranium-235	3.75E-06	2.23E-06	2.88E-05	6.57E-08
Uranium-238	4.21E-04	5.42E-06	1.80E-04	3.53E-06
Thorium-228	3.74E-08	4.28E-08	3.39E-10	
Thorium-230	3.75E-05	4.54E-06	3.40E-10	
Thorium-231	3.61E-06	2.23E-06	9.46E-06	2.21E-07
Thorium-232	2.29E-09	8.39E-07	2.07E-11	
Thorium-234	4.18E-04	5.42E-06	8.01E-05	2.02E-05
Protactinium-234m	4.18E-04	5.42E-06	8.01E-05	2.02E-05
Total	1.39E-03	1.70E-03	7.54E-02	4.57E-05

[a]See Section 2.1 for the sources that make up each group
[b]Plutonium-239/240 is entered as plutonium-239 and uranium-233/234 is entered as uranium-234 in the CAP88-PC model.

2.1 POINT SOURCES

The emission sources associated with the former gaseous diffusion operations are combined into three groups for modeling purposes. The groups were determined based on their proximity to one another. The three groups are as follows:

- Group 1
  - X-622 Groundwater Treatment Facility
  - X-710 Vents (modeling location)
  - XT-847 Glove Box (inactive)
- Group 2
  - X-344A Cold Trap Vent (modeling location)
  - X-344A Gulper Vent

- Group 3
  - X-330 Process Building Cold Recovery and Building Wet Air Evacuation Vents
  - X-333 Process Building Wet Air Evacuation Vents
  - X-333 Process Building Cold Recovery Vent (inactive)
  - X-705 Vents
  - X-623 Groundwater Treatment Facility
  - X-624 Groundwater Treatment Facility
  - X-627 Groundwater Treatment Facility (modeling location).

The emission estimates for minor sources were calculated using the historic data for materials handled/processed through the emissions unit; the air pollution control efficiencies; and the physical state of the material handled. The emission estimates for these sources are periodically re-evaluated and are re-evaluated when there is a change in operation. The minor source emissions will be re-evaluated and updated in 2020.

Emissions for all sources within a group were modeled from the representative stack, the stack which contributes the majority of the emissions within that group. The source groupings reduce the number of modeling runs without having an impact on determining the public dose.

Emissions from the X-330 Process Building, X-333 Process Building and X-344A process vents were calculated based on weekly and quarterly sample trap results. Emissions from the X-705 vents, and X-710 vents were based on mass of materials processed and emission factors provided in 40 CFR Part 61 Appendix D.

Emissions from the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities were calculated based on quarterly influent and effluent sampling at each facility, and quarterly throughput. The activity measured in the effluent sample was subtracted from the influent sample; the difference is assumed to have been emitted from the facility. As a conservative measure, radionuclides that were not detected in the samples were assumed to be present at half the undetected result.

The emissions from the DUF_6 conversion facility were based on data collected from the stack's continuous sampling system. Emissions associated with the DUF_6 Conversion Facility are modeled as a separate source.

Table 3 summarizes the control device information for each source and provides the distance and direction from each source to the nearest resident, school, office or business, and vegetable, meat, and milk-producing farms.

Table 3. Distances to Nearest Public Receptors from DOE Sources

Point Source[a]	Control Device	Control Efficiency	Distance in Meters to the Nearest:					
			Resident	School	Office or Business	Farm		
						Milk	Meat	Veg.
Major Sources[a]								
X-330 Process Building Cold Recovery/Wet Air Evacuation Vent	Cold Traps Chemical Adsorbents	90-95%c 0-95%[c]	1690 ESE	3930 NNW	1370 W	3200 N	1520 ESE, W	8380 ENE
X-333 Process Building Wet Air Evacuation Vent	Chemical Adsorbents	0-95%[c]	1330 ESE	3840 NNW	1860 WSW	2960 N	1230 SE	7890 ENE
X-333 Process Building Cold Recovery Vent	Cold Traps Chemical Adsorbents	90-95%[b] 0-95%[c]	1330 ESE	3840 NNW	1860 WSW	2960 N	1230 SE	7890 ENE
X-344A Cold Trap Vent	Cold Traps Chemical Adsorbents	90-95%[b] 0-95%[c]	1506 WSW	3380 NNW	1440 WSW	2660 N	1860 SSE	8340 ENE
X-344A Gulper Vent	HEPA Filters	99.97%	1506 WSW	3410 NNW	1460 WSW	2680 N	1830 SSE	8320 ENE
DUF_6 Conversion Facility	HEPA Filters	99.9%	976 WNW	4320 N	988 WNW	2033 W	1609 W	3900 NNE

Table 3. Distances to Nearest Public Receptors from DOE Sources (continued)

Point Source[a]	Control Device	Control Efficiency	Distance in Meters to the Nearest:					
			Resident	School	Office or Business	Farm		
						Milk	Meat	Veg.
Minor sources								
X-705 Decontamination Facility and Laboratory Fume Hoods	One area HEPA Others none	99.97% or not applicable	1330 ESE	4020 NNW	1800 W	3200 N	1050 ESE	7960 ENE
X-705 Calciners (3) and Glove Boxes	Wet Scrubber	99%	1330 ESE	4020 NNW	1800 W	3200 N	1050 ESE	7960 ENE
X-705 Storage Tank Vents	None	Not applicable	1330 ESE	4020 NNW	1800 W	3200 N	1050 ESE	7960 ENE
X-710 Laboratory Fume Hoods (39)	None	Not applicable	1254 ESE	4690 NNW	1660 WNW	3930 N	1130 E	8350 ENE
XT-847 Glove Box	HEPA Filters	99.97%	640 SSW	5840 N	980 SE	5150 N	1300 S	9150 ENE

Table 3. Distances to Nearest Public Receptors from DOE Sources (continued)

Point Source[a]	Control Device	Control Efficiency	Distance in Meters to the Nearest:					
			Resident	School	Office or Business	Farm		
						Milk	Meat	Veg.
Minor sources								
X-622 Groundwater Treatment Facility	None	Not applicable	1040 SE	5392 NNW	1293 SSE	2184 WSW	1495 SSE	4804 N
X-623 Groundwater Treatment Facility	None	Not applicable	1040 SE	5392 NNW	1293 SSE	2184 WSW	1495 SSE	4804 N
X-624 Groundwater Treatment Facility	None	Not applicable	579 ESE	4294 NNW	2652 W	2776 SSE	525 ESE	3353 NNW
X-627 Groundwater Treatment Facility	None	Not applicable	1377 ESE	4118 NNW	5421 W	2654 W	1495 E	3439 N

[a]Major sources are continuously monitored when operating.
[b]Based on process knowledge, cold traps are estimated to be approximately 90 to 95 percent effective in trapping gaseous uranium hexafluoride.
[c]Chemical adsorbents (such as activated alumina and sodium fluoride) are approximately 95 percent effective at concentrations above 1 ppm. Below this concentration, chemical adsorbents have reduced efficiency or no effect. Normal concentrations entering the Purge Cascade Chemical Traps are near or below 1 ppm. The sample traps (which follow the control traps) use activated alumina hydrated to 14 percent moisture content, which is much more effective due to an instantaneous reaction of gaseous uranium hexafluoride and technetium-99 with the water to form particulate matter.

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2.2 FUGITIVE AND DIFFUSE SOURCES

Fugitive and diffuse emissions include all emissions that do not pass through a discrete stack, vent, or pipe. Potential emissions of diffuse and fugitive emissions at PORTS include normal building ventilation, soil and groundwater remediation sites, and wastewater treatment facilities.

A Memorandum of Understanding between DOE and U.S. EPA (DOE and U.S. EPA 1995) requires evaluation of airborne emissions from diffuse emission sources, in addition to the point sources evaluated to determine compliance with the 10 mrem/year limit. Ambient air monitoring stations are used at PORTS to confirm that radiological emissions from the site produce a dose much less than the level allowed by regulations. The ambient air monitors are divided into three groups: on site, property line, and off site. One monitor is located 13 miles southwest of the facility to measure background levels of radionuclides.

Samples are collected weekly from the monitoring stations. Samples are then composited into a monthly sample and analyzed for radionuclides representative of PORTS operations. Analyses for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) are performed quarterly based on the infrequent detections of these radionuclides. Analyses of technetium-99, uranium-233/234, uranium-235/236, and uranium-238 are performed monthly. Section 4.3, Table 6, provides a dose estimate for each ambient air monitoring station based on the results of this ambient air sampling.

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3. DOSE ASSESSMENT

3.1 DESCRIPTION OF DOSE MODEL

CAP88-PC Version 4.0, a computer program approved by U.S. EPA for compliance with 40 CFR Part 61 Subpart H, was used to calculate the dose from DOE radionuclide emissions to air. The program uses a modified Gaussian plume equation to estimate the dispersion of radionuclides. The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from ingestion of food produced in the assessment area.

3.2 SUMMARY OF INPUT PARAMETERS

Input parameters for the CAP88-PC model include physical parameters for each radionuclide emission source, radionuclide emissions, meteorological data, and agricultural data. Table 2 (Section 2.) provides the radionuclide emissions for each source. Default values were used for the size and class of each radionuclide. Table 4 provides the physical parameters for each source.

Table 4. Physical Parameters for DOE Air Emission Sources

Parameter	Group 1	Group 2	Group 3	DUF_6 facility
Stack height (m)	10	20	6	21.95
Stack diameter (m)	0.315	0.36	0.2	1.07
Exit velocity (m/sec)	0.45	0.3	11	17.4

Site-specific meteorological data were used in the CAP88-PC model. Data from the National Weather Service were used when necessary to substitute data. The following data were collected for calendar year 2018:

Annual precipitation:	138.86 cm/year
Average air temperature:	12.3 °C (10 meter height)
Average mixing layer height:	893.2 meters
Humidity	9.4 m/m3

The wind files used in the CAP88-PC model were generated from data collected at the 10-meter and 30-meter heights from the on-site meteorological tower. Wind roses showing the prevailing wind directions for calendar year 2018 are shown in Figure 1 (10-meter height) and Figure 2 (30-meter height). The wind roses show that the prevailing wind direction in calendar year 2018 was from the south. With the permanent shutdown of the X-326 Process Building sources, there is no longer a modeled source with a release height that corresponds to the 60m tower. Therefore meteorological data from the 60m tower is not included in this year's report.

Precipitation was measured by an automated gauge near the on-site meteorological tower located on the south end of PORTS near the XT-801 building, which is backed-up by an automated gauge on the north end of PORTS near the X-230L North Holding Pond. Air temperature was measured at the on-site meteorological tower. The location of the on-site meteorological tower is shown on Figure 3.

It should be noted that the default values provided with the CAP88-PC model can be very conservative. The rural food array used to estimate the DOE PORTS dose assumes that the public obtains all foodstuffs within 50 miles of the plant (see Table 5). In reality, the majority of the foodstuffs consumed locally are purchased at supermarkets that receive foodstuffs from all over the world.

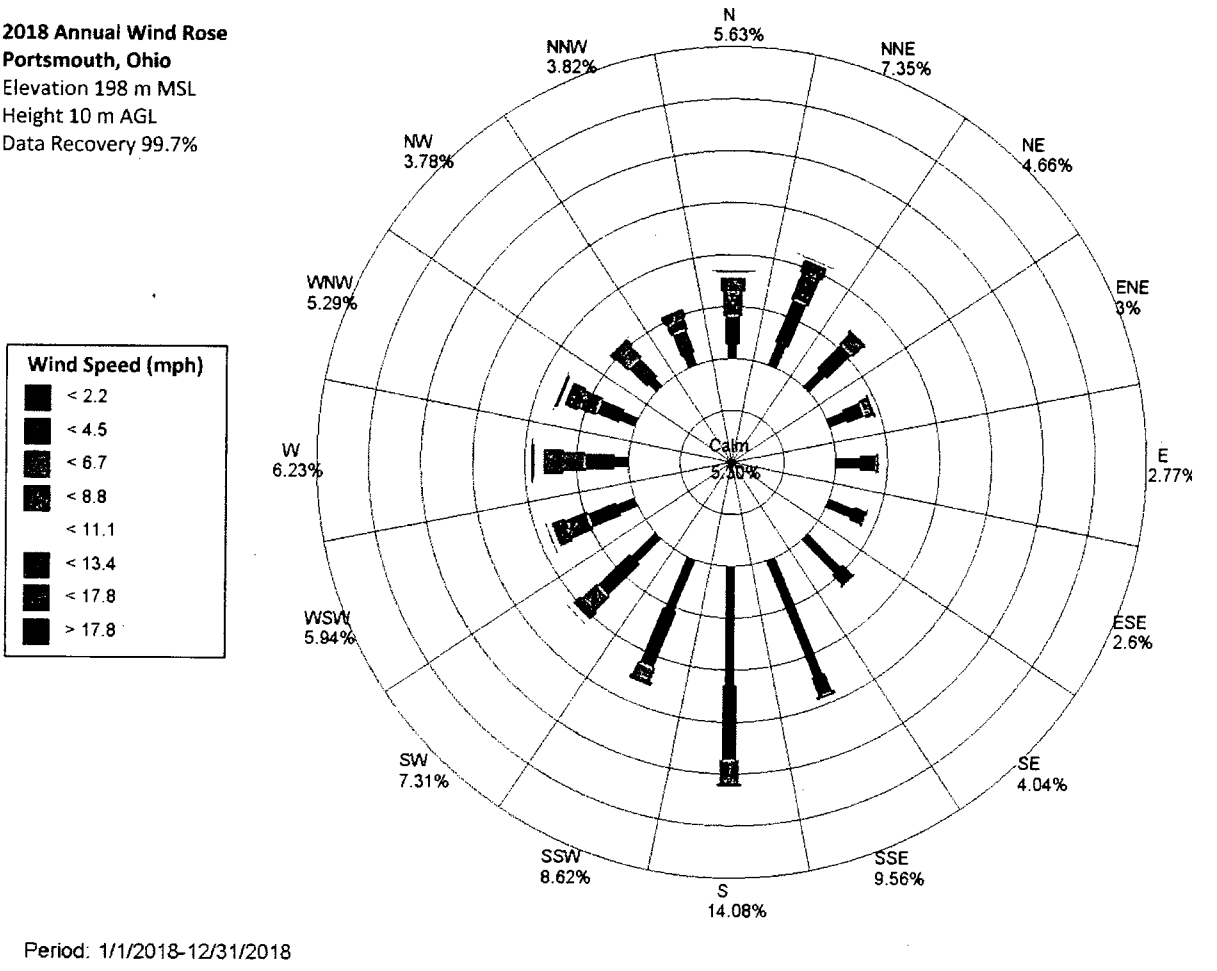

Figure 1. CY 2018 PORTS Wind Rose for 10-meter Height

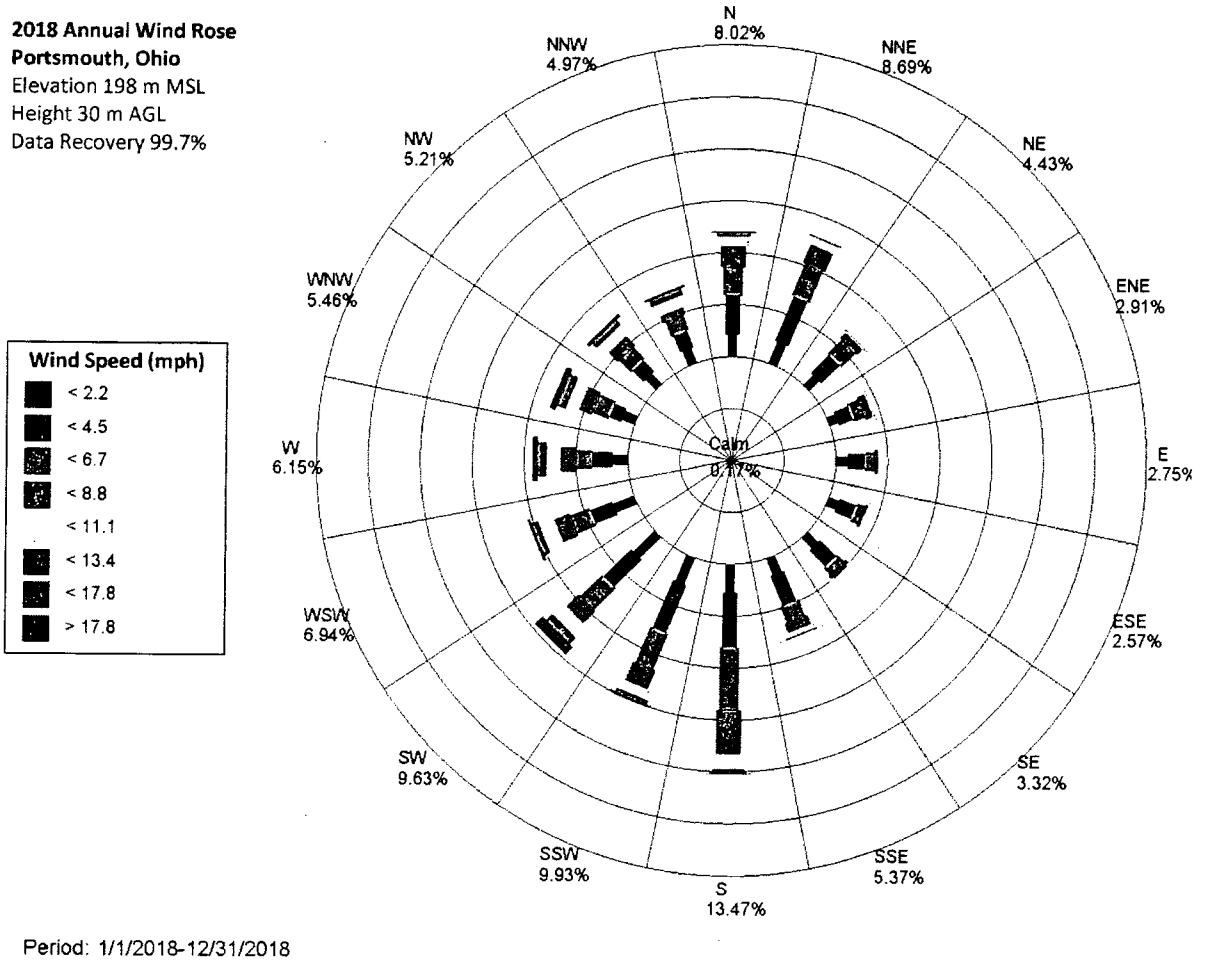

Figure 2. CY 2018 PORTS Wind Rose for 30-meter Height

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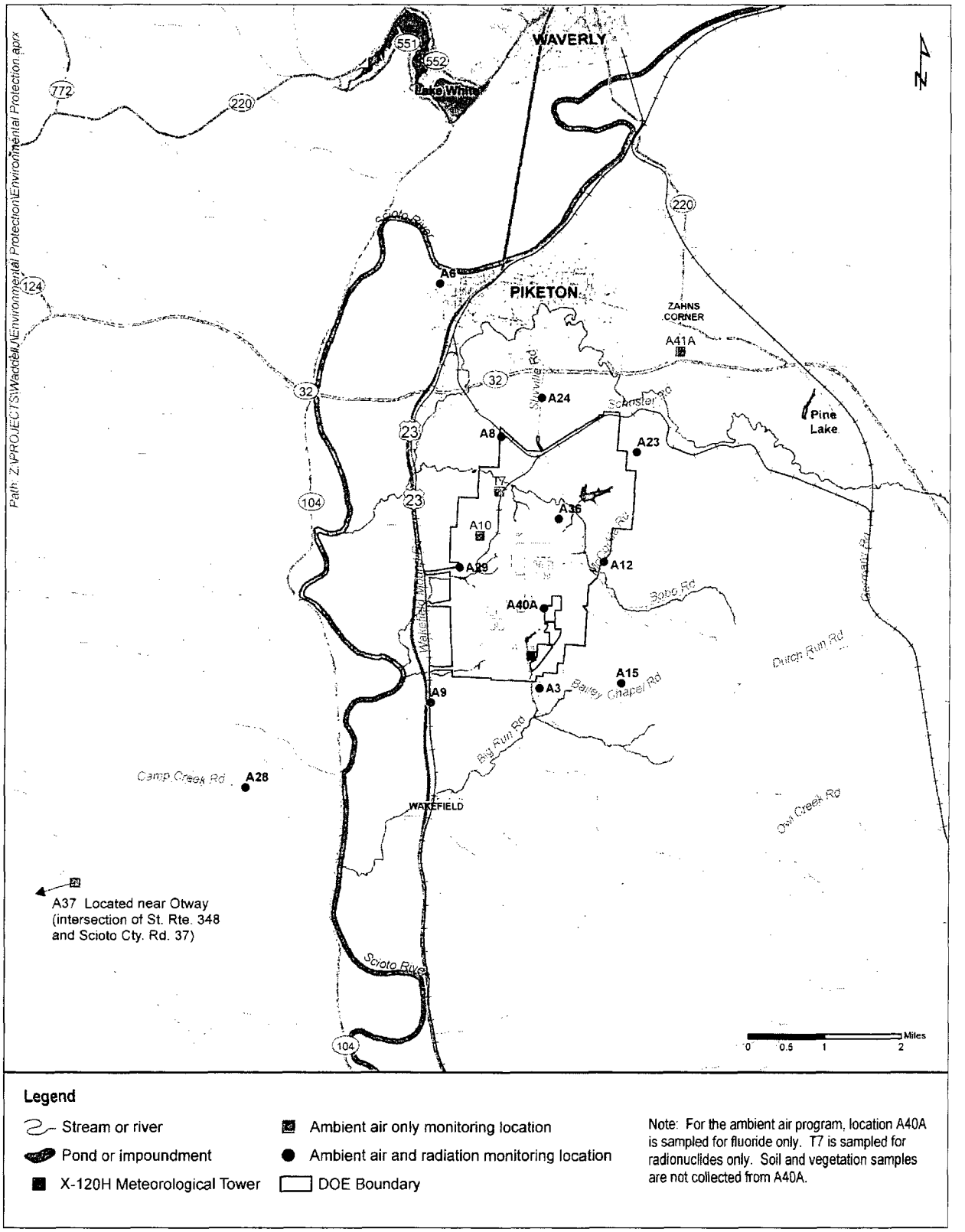

Figure 3. DOE PORTS Ambient Air Monitoring and On-site Meteorological Monitoring Stations

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Table 5. Agricultural Data: Rural Default Food Array Values

Fraction of Foodstuffs	Local Area	Within 50 Miles	Beyond 50 Miles
Vegetables and produce	0.700	0.300	0.000
Meat	0.442	0.558	0.000
Milk	0.399	0.601	0.000

3.3 RESULTS

The CAP88-PC model estimated the 2018 maximum effective dose for the maximally exposed individual (MEI) near PORTS based on emissions from DOE sources to be 0.10 mrem/year. The MEI was located 3284 meters north of the X-627 Groundwater Treatment Facility. This effective dose includes dose contributions from the sources and radionuclides listed in Table 2.

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4. ADDITIONAL INFORMATION

4.1 NEW/MODIFIED SOURCES

There were no new/modified sources during 2018.

4.2 UNPLANNED RELEASES

There were no unplanned releases of radionuclides during 2018.

4.3 DOSE CALCULATIONS FOR EVALUATION OF DIFFUSE/FUGITIVE EMISSIONS

A Memorandum of Understanding between DOE and U.S. EPA (DOE and U.S. EPA 1995) requires evaluation of airborne emissions from diffuse emission sources, in addition to the point sources evaluated to determine compliance with the 10 mrem/year limit. Ambient air monitoring stations (see Figure 3) measure radionuclides released from the DOE point sources (see Table 2), fugitive air emission sources such as those discussed in Section 2.2, and background levels of radionuclides. Samples are collected weekly from 15 stations and composited monthly. Analyses of technetium-99, uranium-233/234, uranium-235/236, and uranium-238 are performed monthly. Analyses for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) are performed quarterly based on the infrequent detections of these radionuclides.

The CAP88-PC model is used to generate a dose conversion factor for each radionuclide. The dose conversion factor is used to compute a dose in mrem/year for a given activity of a radionuclide in air (in picocuries per cubic meter). For radionuclides that were detected in ambient air during 2018, the dose for that radionuclide is calculated by using the maximum activity of each detected radionuclide. For radionuclides that were never detected, the dose is calculated by using half of the highest undetected result to calculate the maximum activity of the radionuclide in air. The doses attributable to each radionuclide are then added to obtain the gross dose for each station. The net dose is obtained by subtracting the dose at station A37, the background monitoring station (the net dose is recorded as zero for stations with a gross dose less than the background station).

Table 6 summarizes the total dose (both gross and net) for each station. The highest net dose for the ambient air monitoring stations was 0.059 mrem/year at station A10, which is located in the west, northwest sector of the site near the Don Marquis substation.

Table 6. Summary of Doses (mrem/year) at Ambient Air Monitoring Stations in 2018

Station	Gross dose	Net dose	Station	Gross dose	Net dose
A3	3.0E-02	0	A24	3.08E-02	0
A6	2.0E-02	0	A28	2.0E-02	0
A8	4.0E-02	0	A29	3.0E-02	0
A9	2.0E-02	0	A36	4.5E-02	0
A10	1.3E-01	5.9E-02	A37 (bkg)	7.0E-02	-
A12	6.0E-02	0	A41A	3.0E-02	0
A15	4.0E-02	0	T7	3.0E-02	0
A23	5.0E-02	0			

These results indicate that fugitive and point source emissions of radionuclides from the PORTS reservation do not cause a significant dose to individuals near the site and further demonstrate that emissions of radionuclides from PORTS are well below the NESHAP limits.

4.4 DOSE CALCULATIONS FOR SECURITY FENCE LINE LOCATIONS

Per request by U.S. EPA Region 5, a dose calculation using the CAP88-PC model was also completed for locations around the perimeter of the security fence of the PORTS process area (the limited access area). Emissions from the DOE radionuclide sources were used to determine the dose to a hypothetical person living at the fence line for the limited access area at each of the 16 directional sectors around the plant (i.e., north, north-northeast, northeast, east-northeast, etc.). The maximum dose a hypothetical person living at the PORTS security fence line would receive from DOE radionuclide emissions is 0.72 mrem/year at the north sector of the security fence line for the limited access area.

4.5 REFERENCES

DOE 1995. *Performance Test Report X-735 Landfill Closure (Northern Portion) Cap Construction and Gas Venting System*, DOE/OR/11-1420&D1, POEF-ER-4626&D1. Lockheed Martin Energy Systems, Piketon, Ohio.

DOE and U.S. EPA 1995. *Memorandum of Understanding Between U.S. EPA and U.S DOE Concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR Part 61 Including Subparts H, I, Q, and T*, joint DOE/EPA agreement, 1995.